The diagnostic accuracy of the Kimberley Indigenous Cognitive Assessment (KICA) tool: a systematic review

Introduction

Aboriginal and Torres Strait Islander Australians (hereafter referred to as Indigenous Australians) have greater levels of socioeconomic disadvantage and poorer health outcomes than non-Indigenous Australians. This is reflected in a higher prevalence of dementia, estimated at three times that of the general Australian population [1].

Assessing cognitive function in Indigenous Australians can be difficult for a number of reasons including different definitions and understanding of mental health in Indigenous Communities [2]. The Mini-Mental State Examination (MMSE) has been found to be inappropriate for use in remote Indigenous Australian communities [3]. The Kimberley Indigenous Cognitive Assessment (KICA) tool was developed as a culturally appropriate tool for older Indigenous Australians living in remote and rural locations [4]. The tool contains a number of different subsections; the KICA-Cog assesses cognition of the individual, predominantly memory and language, and the KICA-Carer collects informant information [4]. The tool takes 25-30 minutes to complete and is freely available online (at https://www.perkins.org.au/wacha/our-research/indigenous/kica/). Since its development there have been a number of publications of modified versions, including a shortened version that takes less than 10 minutes to complete (the KICA-Screen) [5] and a version developed for use in urban and rural Indigenous Australians (the modified KICA or mKICA) [6]. Most Indigenous Australians do not live in remote locations; those living in urban areas are more likely to have received formal education, and thus have higher levels of literacy and to speak English as a first or main language[7]. Therefore, the difficulties with the lack of suitability of the MMSE for use in remote Indigenous populations may not apply.

The question "What is the evidence for the accuracy of the Kimberley Indigenous Cognitive Assessment (KICA) tool for the diagnosis of dementia in Indigenous Australian populations?" was addressed by systematic review.

Methods

A systematic review of the diagnostic accuracy of all versions and subsections of the KICA tool was conducted. This is an update of a review conducted for the development of the Australian Clinical Practice Guidelines and Principles of Care for People with Dementia [8], as new data have been published since that time. A protocol for the Guidelines review was developed *a priori* [9].

Inclusion criteria

The inclusion criteria were studies of the KICA tool reporting the diagnostic accuracy (sensitivity, specificity, or area under the ROC curve or data enabling calculation of these outcomes) for the diagnosis of dementia in comparison to a reference standard of pathology or consensus diagnosis by comprehensive clinical assessment using international standardised criteria (eg. DSM-IV, ICD-10) [10]. Included studies conducted in urban or regional populations were required to compare the KICA to an alternative cognitive assessment tool not specifically targeted at Indigenous populations as these data best inform which test to use in practice. Included studies conducted in a remote population were not required to provide such a comparison as the authors report that the use of other cognitive assessment tools is not considered appropriate in these populations [4]. Case control or nested case control studies were excluded as studies of this design have spectrum bias, are likely to overestimate diagnostic accuracy and do not provide evidence of the accuracy of a diagnostic test in a clinical setting [11]. Peer reviewed or grey literature reports were included.

Search and study selection

English language articles published to 4 November 2015 were identified using OVID MEDLINE (Indexed & In-process), PsycInfo, EMBASE, the Cochrane Library (Cochrane Central Register of

Controlled Trials, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effect, Health Technology Assessment Database) and Alzheimer's Australia, Health Infonet, and the Australian Institute of Health and Welfare (AIHW) websites and google scholar websites and reference lists of included articles. Search terms used were KICA or "Kimberley Indigenous". Title and abstract screening was conducted independently by two authors (SD, KL).

Data extraction

Accuracy data using optimal and previously published or recommended cut-points for the differentiation of dementia from Mild Cognitive Impairment (MCI)/cognitive impairment no dementia/no cognitive impairment (where reported) were extracted by one author and checked for coverage and accuracy by a second. Authors were contacted to clarify study details.

Risk of bias assessment

Two authors independently assessed methodological quality according to risk of bias items for diagnostic test accuracy reviews as outlined in the Cochrane Handbook using Review Manager 5.3 (assessing patient selection, index tests, reference standard and flow and timing based on the QUADAS tool) [12].

Data analysis and synthesis of results

Data were presented by narrative synthesis. Data were not considered suitable for pooling as; (a) most data were for different versions or subsections of the tool; (b) for the KICA-Screen one study was the initial development of the tool whereas the other was for independent testing in a separate population (c) for the mKICA, one study reported the accuracy of the detection of dementia, the other reported the accuracy of the detection of dementia/mild cognitive impairment. There were too few studies to assess heterogeneity.

Results

Search and study selection

Fifty-five citations were reviewed after duplicate removal (Figure 1). Ten articles were excluded after full-text review (see Supplementary data); Five studies reported in four publications of cross-sectional diagnostic accuracy studies of the KICA in Indigenous Australian populations were included (Table 1).

Characteristics of included studies

One study reported the accuracy of the KICA-Cog and the KICA-Carer in a remote Kimberley population [13]. Another article reported the development of the KICA-Screen in this same Kimberley population, with re-testing in a separate population in Northern Queensland [5]. Two studies reported the accuracy of the mKICA; a small pilot study in a NSW urban and regional population [14] and a larger study in a similar population.

Risk of bias and Applicability

A summary of the risk of bias ratings of the included studies is provided in Figure 2. Key risk of bias limitations related were that the cut-point for the index tests was not predefined in the Kimberley studies [5, 13] and in three studies the flow and timing of the conduct of the tests was considered at a high risk of bias as not all patients were verified or this was unclear.

Applicability

There were applicability concerns with regard to applying the results in a clinical setting for all included studies as they were population based and did not represent a series of patients with suspected dementia (Figure 2). The KICA-Screen and the KICA-Carer studies involved development of the tool, so the initial administration of these questions were not in the sequence and format of the final tool.

Accuracy

The KICA-Cog, KICA-Carer and KICA-Screen had a sensitivity and specificity of over 70 percent for the diagnosis of dementia in a Kimberley population (Table 2). The sensitivity and specificity of the KICA-Cog and the KICA-Cog and KICA-Carer conducted in series was 90 percent or greater. The accuracy of the KICA-Screen was somewhat lower when tested in an independent North Queensland population, applying the pre-determined cut-point of 21/22 (Table 2).

In an urban and regional population, the mKICA also had a sensitivity and specificity of 86 percent or over at the optimal cut-point (Table 2). At recommended cut-points, the specificity of the mKICA and MMSE was similar, but higher than that of the Rowland Universal Dementia Assessment Scale (RUDAS) (Table 2). The sensitivity was slightly, but not significantly, lower than that of the MMSE and RUDAS. A small pilot study reported high accuracy of all tests , but the precision of these estimates is limited due to the small sample size [14].

Discussion

The National Framework for Action on Dementia recommends expanding the use of Indigenous specific diagnostic instruments and assessment methods in remote and rural communities, where applicable [15]. The KICA was originally developed following extensive consultation with remote living Indigenous communities and has high acceptability [4]. It has been demonstrated to have high inter-rater reliability and internal consistency [4].

The importance of systematic reviews in informing best practice to improve the health of Indigenous peoples has recently been highlighted [16]. This systematic review identified a number of versions and subsections of the KICA tool which have reported a range of sensitivities and specificities when used in different populations and applying different cut-off points for the diagnosis of dementia. The highest accuracy was for the KICA-Cog/KICA-Carer used in series (both tests positive for an overall positive result). The newly released Australian Clinical Practice Guidelines and Principles of Care for

People with Dementia recommends the use of the KICA-Cog or KICA-Screen in remote living Indigenous Australians, in whom the use of alternative cognitive assessment tools is not considered appropriate due to language, illiteracy or cultural considerations [8]. The use of the KICA-Cog and KICA-Carer in series is likely to further increase specificity for dementia and will therefore decrease false positive rates and associated psychological harms and follow-up.

The mKICA is a modified version of the KICA-Cog which has been developed for urban and rural Indigenous Australian populations. The mKICA as well as the MMSE and the RUDAS were widely acceptable in this population [6]. The results on all three tests were found to be independent of age and years of education. The mKICA had similar accuracy to the MMSE and RUDAS. The Australian Guidelines recommended the mKICA as an alternative to the MMSE in urban and rural Indigenous Australian populations when illiteracy, language or cultural considerations deem it appropriate [8].

The current review is focussed on the accuracy of the KICA tools as these data are the most informative as the basis for guideline recommendations. A limitation of the review therefore is that it does not summarise other data such as acceptability, reproducibility or correlations of cognitive measures with demographic factors or other tools.

In conclusion, data on several freely available versions and subsections of the KICA tool developed specifically for use in Indigenous Australian populations have been published. Although the body of evidence evaluating these tools is currently sparse, these tools have acceptable accuracy in supporting the diagnosis of dementia. Importantly, in remote Indigenous populations, use of the KICA-Cog and KICA-Carer in series is likely to increase specificity of the tool, without compromising sensitivity, thus decreasing the false positive rate. The existing data support expanding the use of the KICA tools in Indigenous populations, when the use of alternative cognitive assessment tools is not considered appropriate due to language, illiteracy or cultural considerations.

References

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Figure 1 study selection flowchart

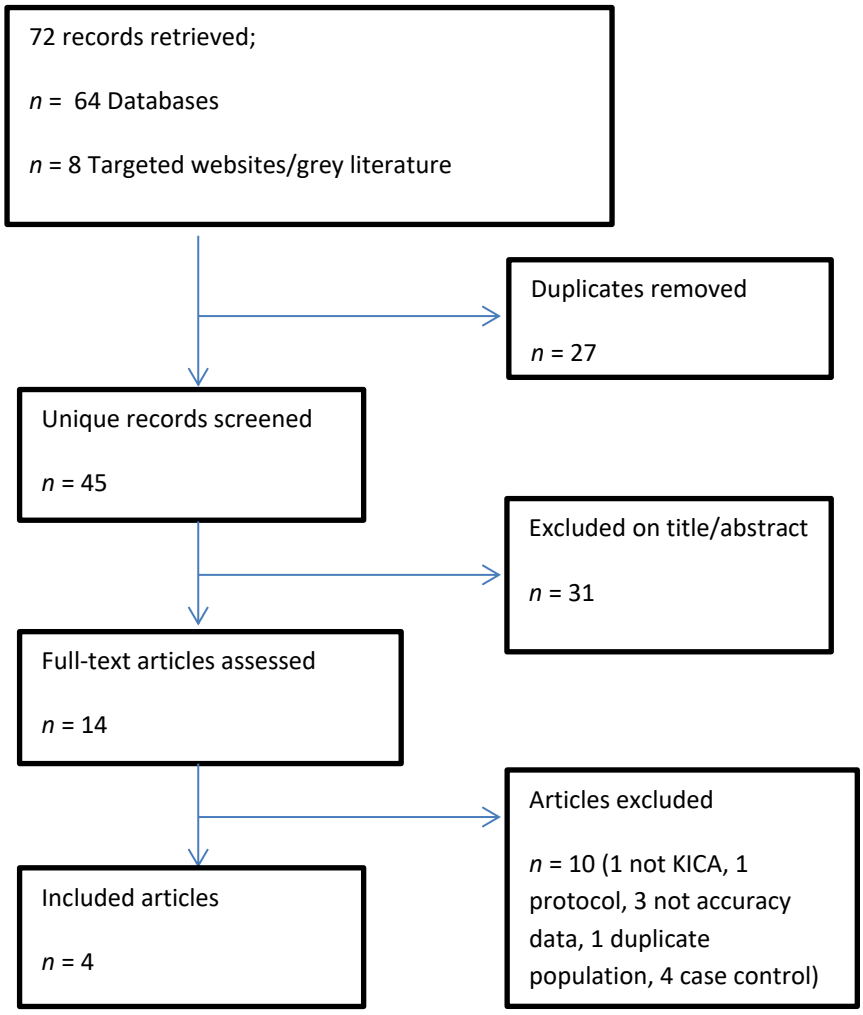

Figure 2 Assessment of methodological quality of included studies

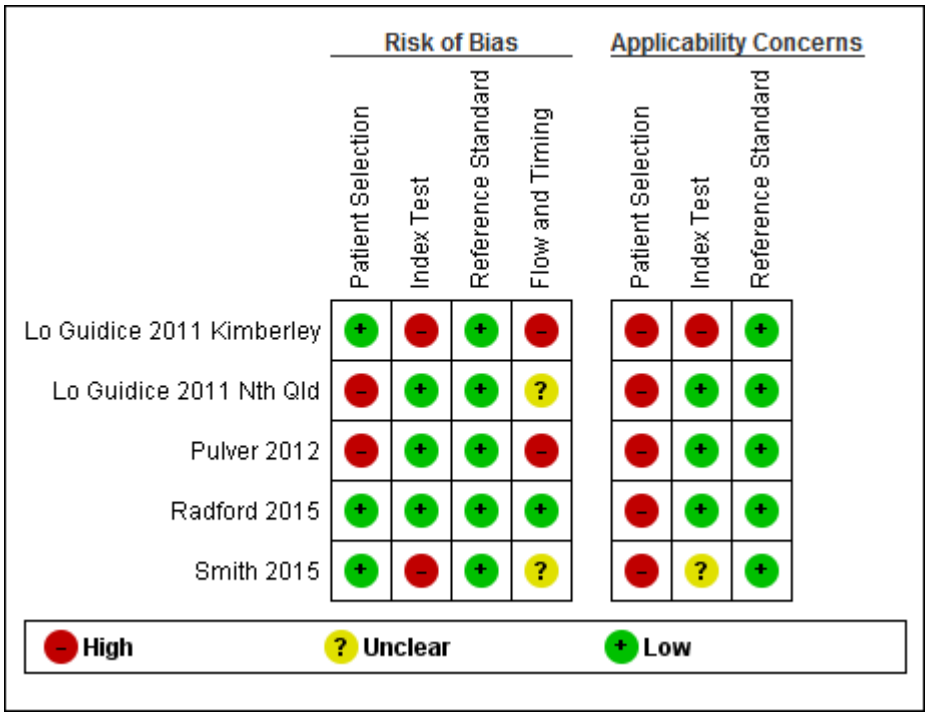

Table 1 Characteristics of included studies

Author, year	Setting Sample	Population N (n, proportion dementia) Age Sex Education	Test	Comparator	Reference standard Verification	Relevant Outcomes Measures
Smith 2016	Remote: Kimberley, WA Semi-purposeful sampling: all residents in 6 remote communities, random sample of 1 in 3 in remote town	Indigenous residents >45 yrs N=349 (n = 42 dementia, 28 CIND, 279 cog intact) Age: mean 60.8, range 45-96 yrs Sex: 55% female Education: NR	KICA-Cog, KICA-Carer	Nil	Consensus diagnosis: Independent review by 2 specialists, using DSM-IV and ICD-10 Verification: 100% of those with KICA <37, random 50% of those KICA = 37, random 5% those scoring >37 $	Sensitivity, specificity, AUC
Lo Guidice 2011, Study 1	Remote: Kimberley, WA Sampling as above	Indigenous residents >45 yrs N=363 (n = 45 dementia, 29 CIND, 289 cog intact) Age (mean ± SD): 60.6 ± 11.9 yrs Sex: 55% female	KICA-Screen	Nil	Consensus diagnosis: Independent review by 2 specialists, using DSM-IV and ICD-10 Verification: 100% of those with KICA-Cog <37, random 50% of those KICA-Cog =	Sensitivity, specificity, AUC

Author, year	Setting Sample	Population N (n, proportion dementia) Age Sex Education	Test	Comparator	Reference standard Verification	Relevant Outcomes Measures
		Education: 40% none formal			37, random 5% those scoring KICA-Cog >37 [$]	
Lo Guidice 2011, Study 2	Remote: North Qld North Qld: Convenience sampling of older people, intentional oversampling of those with cognitive impairment	Indigenous residents >45 yrs N=55 (n = 26 dementia, 17 CIND, 12 cog intact) Age (mean, range): 69.6, 45-95 yrs Sex: 64% female Education: 64% some formal schooling	KICA-Screen	Nil	Consensus diagnosis: Independent review by ≥2 specialists, using DSM-IV and ICD-10 Verification: All verified	Sensitivity, specificity, AUC

Author, year	Setting Sample	Population N (n, proportion dementia) Age Sex Education	Test	Comparator	Reference standard Verification	Relevant Outcomes Measures
Pulver 2012	Urban & regional: NSW, Sydney & mid-north coast Volunteers from community	N = 30 (19 veriified; n = 2 dementia, 7 CIND, 10 cog intact) Age (mean): 58 yrs Sex: 73% female Education (mean): 10 yrs	mKICA	MMSE, RUDAS	Consensus diagnosis 3 clinicians (2 geriatricians & 1 neuropsychologist), using DSM-III-R Verification: 19/30 subjects	Sensitivity, specificity

Author, year	Setting Sample	Population N (n, proportion dementia) Age Sex Education	Test	Comparator	Reference standard Verification	Relevant Outcomes Measures
Radford 2015	Urban & regional (43% urban): NSW communities 3 Sydney, 2 mid-north coast Recruitment through Aboriginal community-controlled health organisations	Indigenous residents ≥60 yrs N = 336 (n = 28 dementia, 26 MCI, 181 cog intact) Age (mean ± SD): 65.8 ± 5.8 yrs Sex: 60% female Education (mean ± SD): 9.6 ± 2.9 yrs	mKICA	MMSE, RUDAS	Consensus diagnosis by ≥3 clinicians (geriatricians & neuro-psychologists), using NIA-AA or Winblad MCI criteria Verification: in all scoring <35 on mKICA, < 26 on MMSE, <25 on RUDAS, 20% of others [%]	Sensitivity, specificity, AUC, LR+, LR-

[$] 11% of those eligible for verification not verified (missing data); unverified test results of KICA-Cog >37 assumed to be true; [%] those without medical assessment within 6 months excluded.

Abbreviations: AUC = Area under the receiver operating characteristic (ROC) curve, CIND = cognitive impairment no dementia, cog = cognitively, KICA = Kimberley Indigenous Cognitive Assessment, MCI = mild cognitive impairment, mKICA = modified KICA, LR = likelihood ratio, MMSE = Mini-Mental State Examination, Nth Qld = North Queensland, Qld = Queensland, RUDAS = Rowland Universal Dementia Assessment Scale, SD = standard deviation, WA = Western Australia, yrs = years.

Table 2 Accuracy of the KICA for the diagnosis of dementia in Indigenous populations

Tool	Study	KICA cut-off	KICA Sensitivity (95%CI)	KICA Specificity (95%CI)	KICA AUC (95%CI)	Comparator, cut-off	Comparator Sensitivity	Comparator Specificity	Comparator AUC
KICA-Cog	Smith 2016	<34	93	90	0.96 (0.94 – 0.98)	–	–	–	–
KICA-Carer	Smith 2016	>2	76	81	0.89 (0.85 – 0.94)	–	–	–	–
KICA-Cog & KICA-Carer in series	Smith 2016	<34, >1	91	94	NR	–	–	–	–
KICA-Screen	Lo Guidice 2011: Kimberley[$]	<22[%]	96	83	0.95 (0.91-0.98)	–	–	–	–

KICA-Screen	Lo Guidice 2011: Nth Qld	<22	82	71	0.87 (0.77-0.97)	–	–	–	–
mKICA	Radford 2015	<37[%]	86 (67 – 96)	90 (85 – 94)	0.93 (0.88 – 0.99)	MMSE, <26[%]	86 (67 – 96)	95 (91 – 97)	0.94 (0.89 – 0.99)
						RUDAS, <24[%]	71 (51 – 87)	90 (86 – 94)	0.89 (0.83 – 0.95)
		<34	57 (37 – 76)	99 (97 – 100)	As above	MMSE, <24	68 (48 – 84)	98 (95 – 99)	As above
						RUDAS, <23	61 (41-79)	92 (88 – 96)	
mKICA	Pulver 2012 (pilot study N =19)	<34	100[§]	90[§]	NR	MMSE, <24	100[§]	90[§]	NR
						RUDAS, <23	100[§]	100[§]	

$ Development of the tool

% Optimal cut-offs

§ Accuracy for detection of cognitive impairment no dementia/dementia vs normal cognition

Abbreviations: AUC = Area under the receiver operating characteristic (ROC) curve, KICA = Kimberley Indigenous Cognitive Assessment, MMSE = Mini-Mental State Examination, Nth Qld = North Queensland, RUDAS = Rowland Universal Dementia Assessment Scale